Lesson 04

ListPlot

Let us import that data from the last problem in the Assignment03. Remember to set the directory first.

```
SetDirectory["Yeshiva"]
SetDirectory["ANGEL"]
SetDirectory["Presentations_Computational"]

Clear[ xt, yt, xy ];
xt = Import[ "TimeHorizontal.dat", "Table"];
yt = Import[ "TimeVertical.dat", "Table"];
xy = Import[ "HorizontalVertical.dat", "Table"];

Now let us make plots with the data
p1 = ListPlot[ xt ]
p2 = ListPlot[ yt ]
Show[p1, p2]
pp = ListPlot[ { xt, yt } ]

Alternatives to the outcome

p1 = ListPlot[ xt , PlotStyle -> PointSize[.02] ]
p1 = ListPlot[ xt , PlotStyle -> {Red,PointSize[.02]} ]
p1 = ListPlot[ xt , PlotStyle -> {Red,PointSize[.02]}, PlotRange -> { 0, 20 } ]
p1 = ListPlot[ xt , PlotStyle -> {Red,PointSize[.02]}, PlotRange -> { { 0, 2 }, { 0, 20 } } ]
p1 = ListPlot[ xt , PlotStyle -> {Red,PointSize[.02]}, PlotRange -> { { 0, 1.5 }, { 0, 15 } } , AxesLabel -> {"Time (s)", "Horizo-
ntal Position (m)"}]
p1 = ListPlot[ xt , PlotStyle -> {Red,PointSize[.02]}, PlotRange -> { { 0, 1.5 }, { 0, 15 } } , AxesLabel -> {"Time (s)", "x (m)"},
LabelStyle -> Directive[ Black, Bold, Medium ] , PlotLabel -> "Horizontal component of the projectile motion"]

line1 = ListPlot[ xt , Joined -> True, PlotStyle -> Green, PlotRange -> { { 0, 1.5 }, { 0, 15 } } , AxesLabel -> {"Time (s)", "x
(m)"}, LabelStyle -> Directive[ Black, Bold, Medium ] ,PlotLabel -> "Horizontal component of the projectile motion"]
line1 = ListPlot[ xt , Joined -> True, PlotStyle -> {Thick, Green}, PlotRange -> { { 0, 1.5 }, { 0, 15 } } , AxesLabel -> {"Time
(s)", "x (m)"}, LabelStyle -> Directive[ Black, Bold, Medium ] ,PlotLabel -> "Horizontal component of the projectile motion"]
Show[ {p1, line1} ]
Show[ {line1, p1} ]

-) Make a plot for the trajectory of the projectile with each recorded position represented by a blue circle. Give a name to
the plot.
pxy = ListPlot[ xy , PlotStyle -> {Blue,PointSize[.02]}, PlotRange -> All , AxesLabel -> { "Horizontal Position (m)", "Vertical
Position (m)"}, LabelStyle -> Directive[ Black, Bold, Medium ], PlotLabel -> "Trajectory of the projectile" ]

-) By clicking on top of it, you can make the plot bigger by dragging the edge with the mouse.

-) You can add additional features to your plot, by choosing Graphics -> Drawing Tools
```

-) Other examples:

```
Clear[squares];
squares = Table[ k^2, { k , 1 , 20 } ];
ListPlot[ squares, PlotStyle -> PointSize[ 0.03 ] ]

Clear[rand];
rand = Table[ RandomInteger[ { 1, 20 } ], { k, 1, 30 } ];
ListPlot[ rand ]
ListPlot[ rand, Filling -> Axis ]
ListPlot[ rand, Joined -> True ]
```

-) Charts

The monthly sales of a certain store (in thousands of dollars) were

JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
5.2	6.3	7.12	13.4	12.6	19.7	20.2	22.6	16.2	15.0	18.4	23.9

```
Clear[months,salesdata];
months = {"Jan", "Feb", "Mar", "Apr", "May", "Jun", "Jul", "Aug", "Sep", "Oct", "Nov", "Dec"};
salesdata = {5.2, 6.3, 7.12, 13.4, 12.6, 19.7, 20.2, 22.6, 16.2, 15.0, 18.4, 23.9};

BarChart[salesdata, ChartLabels -> months]
PieChart[salesdata, ChartLabels -> months]
```

Plot

If instead of a list we have a function, we use Plot, instead of ListPlot

2D plots

```
Plot[Cos[x], {x, -10, 10}]

Plot[Cos[x], {x, -10, 10}, PlotRange → {-2, 2}]

Plot[Cos[x], {x, -10, 10}, PlotRange → {{-20, 20}, {-2, 2}}]

co=Plot[Cos[x], {x, -10, 10}, PlotRange → {{-20, 20}, {-2, 2}}, PlotStyle → Blue]

si=Plot[Sin[x], {x, -10, 10}, PlotRange → {{-20, 20}, {-2, 2}}, PlotStyle → Red]

Show[{co,si}]

Plot[{Cos[x], Sin[x], Sin[x]^2}, {x, -3, 3}]

Plot[{Cos[x], Sin[x], Sin[x]^2}, {x, -3, 3}, PlotRange → {-1.5, 1.5}, PlotStyle → {Red, Black, Blue} ]

Plot[{Cos[x], Sin[x], Sin[x]^2}, {x, -3, 3}, PlotRange → {-1.5, 1.5}, PlotStyle → {{Red, Thickness[0.02]},
{Black, Thickness[0.01]}, {Blue, Dashed}} ]
```

-) To get legends, we need to load a package

```
Plot[{x^2, 2 x^2, 3 x^2}, {x, -3, 3}, PlotRange → {-1.5, 1.5}, PlotStyle → {{Red, Dashed}, {Black, Dashed},
{Blue, Dashed}}, PlotLegends -> {"x^2", "2 x^2", "3 x^2"} ]

Plot[{x^2, 2 x^2, 3 x^2}, {x, -3, 3}, PlotRange → {-1.5, 1.5}, PlotStyle → {{Red, Dashed}, {Black, Dashed},
{Blue, Dashed}}, PlotLegends -> Placed[{“x^2”, “2 x^2”, “3 x^2”},Before]]

Plot[Cos[x], {x, -10, 10}, PlotRange → {-1.5, 1.5}, Filling → Axis]
```

3D plots - can be rotated

```
Plot3D[Sin[x^2 y] Cos[y^3], {x, -1, 1}, {y, -4, 4}]
```

Manipulate and animation

Suppose we want to know how a constant "a" affects the plot of a sine function.

```
*) We could use a do-loop and look at the result for various values
Do[
 Print[Plot[Sin[a x], {x, 0, 2 Pi}]];
 , {a, 1, 5}]

*) An even better way is to use "Manipulate"
Manipulate[Plot[Sin[a x], {x, 0, 2 Pi}], {a, 1, 5}]

*) Two plots together
Manipulate[Column[{Plot[Sin[a x], {x, 0, 2 Pi}], Plot[Sin[a 2 x], {x, 0, 2 Pi}]}], {a, 1, 5}]

*) We can also make a movie. For this we need several snapshots of the image
Clear[anima];
anima = Animate[Plot[Sin[a  x], {x, 0, 2 Pi}, PlotStyle → {Blue, Thick}, AxesLabel → {"Sin", "x"}, LabelStyle →
Directive[Black, Bold, Medium]], {a, 1, 5}]

*) And the movie can also be exported.
(remember to choose the folder where it goes)
Export["Movie_Sin.avi", anima, "AVI"]

*) Variable  is time (to be used next combined with a geometric figure)
Animate[Plot[Sin[ x - t (2 Pi/8)], {x, - 4 Pi, 4 Pi}], {t, 0, 7}]

*) With geometric figures:
Graphics[{PointSize[0.05], Point[{0, 0}]}, PlotRange → {-1, 1}]

Graphics[{{PointSize[0.05], Point[{0, 0}]}, {PointSize[0.05], Red, Point[{0, 0.5}]}}, PlotRange → {-1, 1}]

Animate[Graphics[{PointSize[0.05], Point[{0, a}]}, PlotRange → {-1, 1}], {a, -1, 1}]
```

```
Animate[Graphics[{PointSize[0.05], Point[{0, Sin[a]}]}, PlotRange → {-1, 1}], {a, 0, 2 Pi}]

Animate[Graphics[{PointSize[0.05], Point[{0, Sin[- t (2 Pi/8)]}]}, PlotRange → {-1, 1}], {t, 0, 7}]

Show[Plot[Sin[ x - 0.0 (2 Pi/8)], {x, - 4 Pi, 4 Pi}], Graphics[{PointSize[0.05], Point[{0, Sin[-0.0 (2 Pi/8)]}]}]]

Show[Plot[Sin[ x - 0.5 (2 Pi/8)], {x, - 4 Pi, 4 Pi}], Graphics[{PointSize[0.05], Point[{0, Sin[-0.5 (2 Pi/8)]}]}]]
```

*) Wave and geometric figure together:

```
Animate[Show[Plot[Sin[ x - t (2 Pi/8)], {x, - 4 Pi, 4 Pi}], Graphics[{PointSize[0.05], Point[{0, Sin[-t (2 Pi/8)]}]}]], {t, 0, 7}]
```

Try to solve the problems about interference of Assignment04 together in class.